10/031274
531 Rec'd PCT/PT. 29 OCT 2001

METHOD FOR MEASURING THE SPEED OF A RAIL VEHICLE AND INSTALLATION THEREFOR

Background of the Invention

Field of the Invention

The present invention relates to a method for measuring the speed of a vehicle travelling on a track of railway type.

The present invention also relates to the installation for carrying out this method.

Description of the Related Art

Various systems for determining the speed of a train travelling on a track have already been proposed. In particular, it has been suggested to use a sensor present on an axle to determine the speed of the train travelling on the track. However, this speed is not always sufficiently precise, and in particular, it might not take account of a risk arising when the wheel skids for reasons such as the climatic conditions (frost or snow) or the presence of leaves on the rails.

It has also been proposed to place two or three sensors on different axles in order to obtain better precision. However, this remains insufficient from the point of view of the risk management.

It is also known practice to arrange beacons along railway tracks in order to measure the speed of the vehicle travelling on these tracks. In this case, beacons, which are arranged at known and fixed distances, emit a signal. The vehicle travelling close to this beacon detects, with the aid of an antenna, the passage over the first beacon and measures the time upto the passage of the second beacon. The speed is readily deduced from the known distance between the two beacons and the time taken by the vehicle to cover this distance. Nevertheless, the beacons are placed a relatively large distance apart and this amounts essentially to measuring the average speeds over the distance covered.

It has also been proposed in document WO97/12796 to use a calibrated beacon to determine the almost instantaneous speed of a vehicle passing in its vicinity. This beacon emits a magnetic field and, by means of an antenna placed under the vehicle,

this vehicle can detect the entry into and exit from this field of magnetic influence. The time taken by the vehicle to cross the field of magnetic influence is deduced therefrom, and the speed of the vehicle is thus calculated. This method has the drawback of needing to place beacons at regular distances along the tracks.

Moreover, it is known practice to organize a track into track sections known as "block-sections", which are separated by electric joints. An electric joint consists of two tuning blocks acting as the power coupling for the track sections adjacent to each tuning block and for the short length of track located between these two tuning blocks (15 to 30 metres). Usually, the first tuning block acts as an emitter at a given frequency while the second tuning block acts as a receiver at another frequency. The functions of the electric joint are, firstly, to prevent the propagation of the signal from one track circuit to the adjacent track circuit and, secondly, to couple the emitter and the receiver with the track.

It is already known practice to use an electric joint to detect the passage of a train. Actually, on passage of the train axles, a short-circuit is created between the two rails via the train axles and thus enables the detection of the position of said train relative to the emitter from the change of current in the track. Specifically, it is observed that the current at the F1 frequency in the rail in front of the axle is high before the axle passes at the level of the emitter connection, and undergoes a strong discontinuity at the moment the axle passes.

The document GB-A-2 153 571 describes an example of a track circuit assembly that is particularly suitable for a short track circuit of less than 40 m in length, which may be used in underground railway transit systems.

It is mentioned therein that an electrical short-circuit is produced between the rails and that an AC signal control unit is connected approximately 6 metres later so as to tune the loop thus formed to the resonance, to the frequency of the selected track signal. The control units comprise a capacitor, the value of which is chosen so as to adjust the resonance, and a transformer, one coil of which is mounted in series with the capacitor, a track circuit signal emitter or receiver being connected via a second coil of the transformer.

Summary of the Invention

The present invention aims to provide a solution which can offer the maximum security within the railway context of the term in measuring the speed of a vehicle travelling on a track of railway type.

More particularly, the present invention aims to propose a method which allows the average speed to be estimated independently of the error sources, due, for example, to skidding and to engagement of the axles, and which is based on the detection, when a train passes, of joints separating the various track circuits.

The present invention aims to propose a system which can dispense with the installation of beacons along the tracks.

More particularly, the present invention aims to use already existing train-locating equipment which consists of track circuits with electric joints.

The present invention relates to a method for measuring the speed of a vehicle provided with an antenna and travelling on a track with two rails in the form of track sections known as "block-sections" separated by electric joints, each electric joint consisting of two tuning blocks and of the predetermined track section located between them, each of the tuning blocks allowing the power coupling for the adjacent track section acting as a block-section, characterized in that at least two discontinuities are detected in the current or voltage of the signal as seen by an antenna which is present in the vehicle travelling on the track in the immediate vicinity of the first and second tuning blocks of the same electric joint, in order to measure the speed of the vehicle travelling on the track.

The first discontinuity is obtained when the axle passes at the level of the first tuning block for the frequency of this first tuning block.

The second discontinuity is obtained by exerting an electrical action at the frequency of the first tuning block. This second discontinuity is obtained by creating an electric or magnetic field in the area of the second tuning block. This electric or magnetic field is generated by means of a current which is proportional to the current emitted by the voltage injected into the first tuning block. This field is generated directly by the current emitted by said voltage.

According to another embodiment, the electrical action is a voltage injected in

series with the voltage at the second frequency of the second tuning block. This voltage injected in series is proportional to that which is injected into the first tuning block.

According to another embodiment, the electrical action is the injection of a current into a voltage generator which is present in the second tuning block, this current travelling round a loop arranged between the rails, said current being proportional to the current emitted by the voltage injected into the first tuning block.

The signal detected by the antenna which is on board the vehicle travelling on the track is filtered at the frequency of the voltage injected into the first tuning block.

The present invention also relates to an installation for carrying out the method as described above, in which the track is organized in the form of block-sections separated by electric joints, each electric joint consisting of at least two tuning blocks and of the short track section located between them. This installation comprises means for generating at least two current or voltage discontinuities in the signal as seen by the antenna which is present in the vehicle travelling on the track in the immediate vicinity of the first and second tuning blocks of the same electric joint.

Brief Description of the Drawings

Figure 1 represents the electric diagram equivalent of an electric joint.

Figure 2 represents the equivalent diagram of a track circuit between two electric joints as described in Figure 1.

Figure 3 indicates the effect of the axles on the current in the rails in front of the axles before the axle passes.

Figure 4 indicates the effect of the axles on the current in the rails after the axle passes.

Figure 5 represents the diagram of the current in the rails in front of the axles according to the prior art.

Figures 6, 7 and 8 represent several different embodiments of the invention.

Figure 9 represents the diagram of the current in the rails in front of the axle according to the invention.

Detailed Description of the Preferred Embodiment

An electric joint as represented in Figure 1 comprises a first tuning block TU.F1 located on a first side (left), which will serve as an emitter in order to generate a voltage in the track at the frequency F1 and allows the power coupling of this first side (left) of the track adjacent to the tuning block. A second tuning block TU.F3, located at a distance of 15 to 30 metres, allows the power coupling of the other part of the track (right) adjacent to this tuning block. This second tuning block serves as a receiver for a frequency F3. It might optionally also act as an emitter, which would allow a voltage to be generated at the frequency F3.

Figure 2 represents a track circuit comprising several track sections organized into block-sections and separated by electric joints, each consisting of two tuning blocks coupled in pairs. For a frequency F1, the two tuning blocks TU.F1 and TU.F1' are equivalent to a capacity which performs the tuning of the track section (block-section 1) comprised between these two blocks, while the two tuning blocks TU.F3 and TU.F3' are equivalent to short-circuits at this same frequency (F1). At the frequency (F3) of the adjacent track circuits, the function of the tuning blocks is then inverted.

As represented in Figures 3 and 4, a shunt or short-circuit is created between the rails 1 and 2 when the axle 3 passes. More specifically, the behaviour of the current I generated at the frequency F1 and present in the track 1 in front of the axle 3 is modified.

As shown in Figure 5, it is observed that the current I at the frequency F1 remains high up to the moment at which the axle approaches the emitter TU.F1 which generates the signal at the frequency F1. At the level of said emitter, it is observed that the current I at the frequency F1 falls suddenly, creating a first discontinuity 7 at that point. Figure 5 shows in details the behaviour of the current I in front of the axle, taking into account the position of the emitter TU.F1 on the x-axis serving as reference, whereas TU.F3 is situated at 18m.

The present invention consists in creating a second discontinuity 8 in the immediate vicinity of the second tuning block TU.F3 and in using these two discontinuities occurring at a known distance in order to be able to calculate the average speed of the train between the two positions at which said discontinuities occur.

To this end, it is envisaged to detect on board the train a signal resulting from the magnetic field generated by the current I. More specifically, the voltage V obtained by filtering the antenna signals in a known manner will be proportional to the current I present in the rails in front of the axle 3. This signal is caught by at least one antenna of known type arranged upstream the first axle 3. The signal is filtered at the frequency F1 in order to allow the detection of the two discontinuities 7 and 8 of the current I. One or more other signals at the frequency F3 or at other frequencies may also be used for detecting other pairs of discontinuities occurring on other track circuits.

According to a first embodiment of the present invention, which is more particularly represented in Figure 6, it is suggested to arrange a loop 4 between the rails 1 and 2 close to the block TU.F3 acting as receiver and equivalent to a short-circuit at the frequency F3. This loop 4 is supplied with a current at the frequency F1 which is preferably proportional to the current in the block TU.F1. It is preferably connected in series with this block. Advantageously, the magnetic field generated by the loop 4 creates the second discontinuity 8 required to carry out the method according to the present invention. According to another preferred embodiment of the invention, which is more particularly represented in Figure 7, it is proposed to connect a voltage generator 5 at the frequency F1 in series with the block TU.F3. In this case, the block TU.F3 is equivalent to a short-circuit for the frequency F1. The generator 5 is preferably supplied from the power supply for the block TU.F1.

The second discontinuity 8 will be obtained during passage at the block TU.F3 (x-axis = 18m), the voltage being proportional to that of the block TU.F1 (emitter at the frequency F1).

According to another embodiment, represented in Figure 8, a current generator 6 is connected in parallel to the terminals of the block TU.F3. The current thus generated travels round the loop 9 arranged between the two rails 1 and 2, thus creating a magnetic field that is detectable at that point. The generator 6 at the frequency F1 is advantageously arranged in series with the block TU.F1 and thus creates the second desired discontinuity 8.

Figure 9 shows the current I as a function of the distance travelled on the rails by positioning the block TU.F1 creating the first discontinuity at 0and the block TU.F3

creating the second discontinuity at 18m. One may detect a signal on board by filtering the antenna signals at the frequency F1 and detect the presence of the two discontinuities 7 and 8 whose descending slopes are linked to the precise position of the blocks TU.F1 and TU.F3.

Conventionally, the detection of these two detected discontinuities will be processed using a microprocessor, which makes it possible to define the time interval between the detection of said discontinuities. Conventionally, knowledge of the precise distance between the blocks TU.F1 and TU.F3 will make it possible to calculate the average speed of the vehicle travelling on said track between the two blocks TU.F1 and TU.F3.

In a particularly advantageous manner, it is observed that the cost of installation of the additional device is relatively low and thus makes it possible to obtain a relatively precise measurement of the speed of the train travelling on a track. In addition, the measurement of this speed remains independent of the precise positioning of beacons, for example, the movement of which might occur in the event of maintenance work on the track, climatic phenomena, skidding of the wheels, etc.